



Outstanding Croatian Scientists in Diaspora

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Abstract

Nine books entitled Distinguished Croatian Scientists in America (two volumes) and Distinguished Croatian Scientists in the World (seven volumes), edited by Janko Herak, have been published by the Croatian-American Society in Zagreb. These books present major scientific achievements and essential biographical data of about eighty Croatian scientists, working in prestigious international institutions. The biographies, presented by a separate chapter for each scientist, have been written by domestic or international experts in the respective fields. In the present report we recall just a few scientists and their noted contribution to the international scientific knowledge. It has been emphasized that the achievements of the Croatian scientists working abroad make a part of the Croatian scientific heritage.

During the entire history of mankind, migration of people has been quite common. There are numerous reliable written documents witnessing massive, collective translocation of people. Some of those large moves have been observed by still living witnesses. Massive migrations have usually been a consequence of war, persecution after a war, or of some sort of natural disaster, giving rise to famine, illnesses or other inconveniences. The Balkan region is a good example for that. In more peaceful times migration has a more individual character, which could also result in emigration of a large number of people, driven mostly by economic and/or political reasons. People are simply driven by a possibility of better standard of living and more freedom. Often very important motivation for better educated individuals is expectation of a better possibility for fertilization of their ideas. These are the people driven by the spirit of enquiry, having in mind some kind of amelioration. In the receptive country they expect to find general support for inventions and necessary facilities and infrastructure to materialize their ideas. Educated and talented young people inclined to science, or the people who have already demonstrated their capability in scientific investigations, are often gladly accepted or even solicited for some highly sophisticated work in the receptive country. That is a well-known phenomenon of the brain drain.

It is quite generally accepted that science is one of the human activities that characterizes a society or a nation, because science represents a driving economic force, and at the same time it is a part of the general culture of the society. Therefore, it is conceivable that science is of interest for the institutions of national importance, such as government bodies and specialized agencies, academies, research institutes, universities etc. Croatia, as a nation of emigrants, has a significant population of scientists living and working abroad. That drain has been particularly large since the middle of the last century. By coming to a new country,

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generally more developed, these people often reach scientific excellence and become internationally recognized as members of their new institutions in the receptive country. However, they were born and educated in Croatia or raised in Croatian families abroad. Some of them started their scientific careers already in Croatia or even made scientific discoveries of international value at home. By moving to a new country they bring along the civilizational, cultural, historical, traditional, educational and other determinants of their homeland, which obviously influence their further work in the new country. Therefore, these people are considered to belong also to the Croatian scientific community, and their achievements are as well a part of the total Croatian national scientific heritage.

In a new country the publications of the Croatian scientists are assigned to the institutions of their new homeland. This makes that part of the Croatian scientific corpus difficult to recognize. The Croatian scientific community and the respective national institutions are expected to register and bring to public the fact that the scientific achievements of the Croatian diaspora make a part of the Croatian scientific wealth. Ignoring that fact would mean the same as to renounce the great and already famed Croatian scientists like Ruđer Bošković, the universal 18th century scientist, Nikola Tesla, globally renowned physicist and inventor, or the 20th century scientists: Milislav Demerec, one of the leading scientists in genetics and the long-term director of the famous Cold Spring Harbour Laboratory and Genetics Department of the Carnegie Institution of Washington, and Lavoslav Leopold Ružička and Vladimir Prelog, the Nobel-prize laureates in chemistry.

About two decades ago, upon the initiative of several Croatian scientists, the Croatian-American Society in collaboration with the Matrix Croatica and the Croatian Heritage Foundation in Zagreb, began to search for distinguished Croatian scientists in the USA, aimed at learning more on their work and achievements. In 1996 and 1998 two symposia dedicated to scientific and personal biographies of seventeen scientists working in America were organized and the proceedings of those meetings were published bilingually (in Croatian and English) in two respective books entitled *Distinguished Croatian Scientists in America* (1, 2). It appeared that there were many more reputable Croatian scientists in the USA and also those who had made their decisive study and research in America before moving to some other country in Europe, Australia or elsewhere. That fact stimulated a broader search for eminent Croatian scientists all over the world. That quest have resulted in finding about one hundred Croats who have worked abroad in a broader field of natural sciences, satisfying high criteria of scientific excellence. In total, more than eighty of them have been the subject of our study. Their personal and scientific biographies have been investigated and the results published in

Croatian and English in additional seven books, entitled *Distinguished Croatian Scientists in the World* (3).

It has to be pointed out that the number of Croatian academic people in diaspora, working with various universities, academic and industrial institutes, hospitals, government agencies etc., is counted in thousands. Our goal has been to select only those whose scientific achievements make them globally recognized in their field of research. Their excellence is judged by the number and quality of the scientific papers and patents, by their positions in the institutions they work and by public recognitions received. In order to select the “celebrities”, the Editor of the books (the author of this presentation) has consulted public sources of information and domestic and foreign specialists in the respective field for each candidate. The responsibility for the final selection is solely his. The next step has been to find out a person willing to study the candidate in more detail and write a qualified paper (chapter) for the book.

It has been found that more than 50% of all the scientists treated in these books have been working in the USA, and additional 10 % in Canada. More than 25% of the “celebrities” found their positions in Europe and 5% in Australia. The Croatian-American scientists in the USA have been distributed mostly in the north-eastern states (New York and Massachusetts) and in California. In Canada we have found distinguished Croatian scientists mostly at two universities: McGill University in Montreal and the University of Toronto. In Europe, the largest number of scientists have been registered in Germany and Switzerland. Whereas the distribution in Germany is rather disperse, in Switzerland, the European Organization for Nuclear Research (CERN) and the two national universities, ETH in Zurich and EPFL in Lausanne, have been attractive for the Croats. In Australia most Croatian-Australian scientists have been associated with large universities.

The complete list of the Croatian scientists presented in the above books, their latest affiliation and the field of research could be found at the internet address www.cas.hr/publikacije/?lang=eng. The largest number of them have been working in the field of biomedicine. Instead of describing the achievements of each of them, there will be just a short note on some representative people in each field. We find that Krešimir Krnjević and Mladen Vranić, professors of medicine at the McGill University in Montreal and the University of Toronto, respectively, belong to the earlier generation of emigrated renowned scientists of biomedical profile. Dr Krnjević is known for important contributions in elucidation of chemical regulation in the brain. To date his findings of the inhibitory action of neurotransmitter GABA and excitatory action of glutamate belong to the common knowledge. Dr Vranić has pioneered in quantifying hormonal interactions in glucoregulation and pathogenesis of diabetes with the use of

the tracer methods. He has emphasized the significance of glucagon-insulin interactions in health and diabetes. Both of them have acquired numerous recognitions in the scientific world and also the most prestigious Canadian civic order *Officer of the Order of Canada*.

Equally impressive is the work of the two Croatian scientists at the Department of Medicine of the Yale University. Paško Rakić is Professor of Neuroscience and Professor of Neurology, and also Director of the Kavli Institute of Neuroscience at Yale. His discoveries in the field of neurosystem development and function has been widely known. Since 2016 he has been Fellow of the Royal Society-London, the first Croat elected to that prestigious society after Ruđer Bošković in the 18th century. Joseph Schlessinger, the Member of the American Academy of Arts and Sciences, born in Croatia during the Second World War, is Professor and Chairman of the Department of Pharmacology. He has found some important pathways of cell signalling in many cell processes. Ultimately, his discoveries have led to the development of drugs for treating gastrointestinal tumours.

In more recent years a number of biomedical scientists have made significant discoveries by using modern biological and biophysical methods. Let us just mention Miroslav Radman, who has discovered the repair mechanism of the biological damage, Ivan Đikić, the founder of important cell control mechanisms, and Nenad Ban, the first author of the Nobel-prize winning paper on the ribosome structure. Three Croatian-Australian biophysicists should be added to that group. Stjepan Marčelja has been the first to present a modern theory of the cell membrane structure. Frances Šeparović has made important discoveries in elucidation of structure and properties of polypeptides, potential drugs, imbedded in the lipid membranes. Boris Martinac has discovered, cloned and structurally and functionally characterized mechanosensitive ion channels. All these people are full members of the respective national academies of sciences (French, German and Australian).

Besides the above-mentioned biophysicists, there are a number of people working in other branches of physics who deserve our attention. Here only two will be mentioned. One is Daniel Denegri, a nuclear physicist, associated with the French Particle Physics Center in Saclay and the European Organization for Nuclear Research (CERN) in Geneva. His major contribution is participation in two great projects in CERN: detection of the W and Z particles, markers of the unified electromagnetic and weak nuclear forces, and the search for the Higgs boson in the Large Hadron Supercollider. Both of these projects have been successful, awarding the project leaders by the Nobel Prize. From a number of successful Croatian younger physicists abroad, perhaps the most successful is Marin Soljačić, full professor with the prestigious MIT in Boston. He is already famous by the long-range reso-

nant transfer of electromagnetic energy and by numerous high-ranking contributions to optics and photonics. He is the author of more than thirty patents.

Chemistry has been a successful branch of science for Croats, both at home and abroad. Besides already well-known Lavoslav Leopold Ružička and Vladimir Prelog, an additional marked figure in Croatian chemistry is Egon Matijević, Distinguished Professor with the Clarkson University (Potsdam, N. Y.). He is one of the leaders in colloid chemistry. In his 560 scientific papers he has demonstrated the skill in preparation of a variety of well-defined colloid particles, suitable for various applications, and in understanding the laws governing the processes of their preparation and their characteristics. He was one of the crucial people in establishing the Department of Chemistry and the Institute of Colloid and Surface Chemistry at the University.

Not many people in Croatia are familiar with the outstanding scientific performance of Dubravko Justić, the Texaco Distinguished Professor in Oceanography in the Department of Oceanography and Coastal Sciences at the Louisiana State University in Baton Rouge. He has developed the computer models that take into consideration various biological, chemical and physical processes to analyse the mechanism and the rate of formation of hypoxia in the Gulf waters. His complex biophysical models of coastal waters have been assimilated into the management plans of the largest watershed in North America.

Several scientists described in the present project have been very successful in the interdisciplinary approaches and skills in using computers. Igor Mezić, Professor and Director of the Centre for Energy Efficient Design at the University of California at Santa Barbara, has encompassed several mathematical subjects in nonlinear dynamics, applied in fluid mechanics, nanotechnology, energy efficiency in buildings, environmental pollution and social sciences. Solving the complex differential equations describing fluid dynamics has also been the subject of Sunčica Čanić, Distinguished Culler Professor and Director of the Centre for Mathematical Biosciences at the University of Houston. She has been very successful in describing blood flow in cardiovascular system and stent modelling. She has been chosen by the Mathematical Society to present mathematics research at the Coalition Science Funding at the US Congress. Particularly interesting is the profile of Jakša Cvitanich, Professor of Mathematical Finance at CALTECH. Cvitanich has applied Brownian motion to develop the models of portfolio optimization, reduction of potential losses, of hedging and other financial subjects.

It should be mentioned that in the present series of books there are several mathematicians, like late William Feller (Princeton), Zvonimir Janko (University in Heidelberg) and Mladen Bestvina, (University of Utah, Salt Lake City), whose fundamental contributions are praised

in their field, but not understood in a broader scientific community due to their complexity.

In the present era of the extremely fast development of the computer science, a prominent name is that of late Branko Souček, originally from the Ruđer Bošković Institute and the University of Zagreb. After building the first computer in Croatia he served in the Brookhaven National Laboratory and the University of New York, University of Arizona and finally as the Director of the IRIS group in Bari (Italy). He is globally known as the author of a dozen books, most of them published by the Wiley Publishing Corporation. His intriguing last book entitled "Better Life and Business: Cell, Brain, Mind and Sex Universal Laws" (Kindle Edition) is available only via personal contacts. Another noted scientist in the computer science is Zvonko Vranešić, Professor Emeritus of the University of Toronto. He is best known through his computer architecture studies and even more by his five textbooks, translated in eight languages and sold in about 800.000 copies all over the world.

Quite a remarkable number of electrical and electronic engineers have made impressive carriers by working on instrumentation in various large research centers. A good example is Dr Veljko Radeka, Head of the Instrumentation Division in the Brookhaven National Laboratory. In his fifty-year career he has participated in innumerable constructions and experiments. He is best known by his contribution to the design of the argon detector of nuclear particles, used not only in large nuclear accelerators but also in magnetic resonance imaging, neutron crystallography, recording of the celestial dynamics etc. His decisive participation in the experiment on the extraterrestrial neutrinos led to the Nobel Prize, awarded to the head of that project.

The list of distinguished Croatian scientists abroad presented in nine books mentioned above is not complete. Some persons did not like to be publicly evaluated while still alive, and for some others we could not find a qualified person willing to do the necessary study and write an appropriate chapter. In addition, there are some potential candidates who escaped our attention. At present we are aware of at least a dozen additional scientists satisfying the criteria of excellence. Let us name only some. Stanislav Duško Ehrlich presently Director of Centre of Host-Microbiome Interactions at King's College, London, previously the founder and the Director of the Microbial Genetics Research Unit and the Microbiology Department at the National Institute of the Agricultural Research (INRA), France. He is probably the most cited Croatian

scientist. Dražen Prelec joined two apparently quite different fields of science. He is Professor of Brain and Cognitive Science and Professor of Economy at Sloan School, MIT, Boston. Igor Rudan, since 2016 Fellow of the Royal Society-Edinburgh, Professor of International Health and Molecular Medicine and Joint Head of the Centre for Global Health Research. Igor Štagljar, Professor of Biochemistry and Medical Genetics at the University of Toronto, has developed technologies to study integral membrane proteins and their transport in the development of malignant diseases.

Nevertheless, even the present collection represents a valuable reference of close to 2000 pages to that part of the national scientific wealth which is, as a rule, not apparent. True, from time to time the national news media bring some information on that subject. However, the texts in the present series of books, written by qualified scientists, bring to public the scientific compendium for each person. Each chapter makes a good start-point for a possible further study. The books have been widely disseminated in Croatia and can also be found in some international libraries.

The question arises what is the benefit for Croatia from the scientific celebrities working abroad? It would certainly be more appreciated if they returned home while still scientifically active. The fact is that once they reach international reputation they do not return. However, they are still helpful in many ways. They participate in the domestic activities like scientific collaboration, delivering lectures, serving as referees, co-organizing scientific meetings, participating in defining scientific policy and in providing advanced facilities and laboratories for young people to work for their doctoral degree or postdoctoral study. For such a small and not enough developed country like Croatia it is important to establish close contacts with the international centres of excellence and at the same time have well trained scientists at home, thus keeping the scientific activities at home at the international level.

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